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Global warming mitigation and renewable energy policy development from the Kyoto Protocol to the Copenhagen Accord—A comment

Lee Chung Lau, Keat Teong Lee*, Abdul Rahman Mohamed

Low Carbon Economy (LCE) Research Group, School of Chemical Engineering, Engineering Campus, Universiti Sains Malaysia, 14300 Nibong Tebal, Pulau Pinang, Malaysia

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ABSTRACT

Global warming is a grave environmental issue that has caught the attention of the globe. Due to the consequences of global warming, UNFCCC has established the Kyoto Protocol and the Copenhagen Accord as measures of combating climate change due to the emission of greenhouse gases. It has been three years since the first commitment period of the Kyoto Protocol and the Copenhagen Accord was just newly established. Therefore, there is a necessity to evaluate the performance of the Kyoto Protocol and to comment upon the Copenhagen Accord in its contributions toward climate change mitigation. Major greenhouse gas (GHG) emitters who are among the Kyoto Protocol ratifying developed nations exhibit the potential to achieve the desired Kyoto pledges through the aid of Clean Development Mechanisms (mainly from using renewable energy), as proposed in the Kyoto Protocol. However, the nullifying effects from non-ratified major emitters like the US and ratified but still developing countries have difficulties in adhering to the Kyoto Protocol. The Copenhagen Accord, on the other hand, is considered to be less ambitious and provides limited financial aid through the Copenhagen Green Climate Fund. The formulation of such a document indicates that modern societies continues to waste time in negotiations that emphasize on individual economic and political advantages, rather than taking into account true global considerations. It raises questions regarding how much time is needed before we decide to fully commit to the effective and collective efforts of climate change mitigation.

Contents

1. Introduction

Global warming has become renowned as one of the gravest environmental issues to catch the attention of the globe in recent decades. It is a consensus view that global warming is an unequivocal result of anthropogenic emission of greenhouse gases (GHG) that remain like a blanket in the atmosphere, thus preventing the reflection of heat back into outer space. Consequently, the average earthly temperature has increased by 0.7 °C since the pre-industrialization period. This diminutive rise of temperature has resulted in climate change that has caused devastation to ecosystems and is affecting sustainable social and economic development. One of the consequences of global warming is the melting of ice in Greenland and the South Pole, and with the thermal expansion of water, a subsequent increase in sea level could take place, which could possibly submerge coastal areas that are often densely populated.

The United Nations Framework Convention on Climate Change (UNFCCC) established the Kyoto Protocol in 1997, deeming it indispensable and necessary to curb the severe damage being caused by global warming. The Kyoto Protocol demarcated that a global effort in climate change mitigation aims to reduce GHG emissions from Annex I countries (developed countries) by 5.2%, with the year 1990 as baseline in the first commitment period of

* Corresponding author. Tel.: +604 5996467; fax: +604 5941013.
E-mail address: chktlee@eng.usm.my (K.T. Lee).

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2008–2012. The Kyoto Protocol proposes three mechanisms (Clean Development Mechanism (CDM), Joint Implementation, and Emission Trading) to assist the developed ratified nations in achieving their assigned Quantified Emission Reduction Limitation or Reduction Commitment (QELRC) in a more economically feasible way. On the other hand, developing countries have participated in GHG emissions abatement through common but differentiated responsibility principles, as no QELRC is allocated. Primarily, developing countries could participate in CDM projects or formulate new environmental policies in accordance to the objectives of the Kyoto Protocol.

After establishing the Kyoto Protocol, discussions of climate issues by the Conference of Parties (COP) have been taking place annually. In December 2009, The 15th COP drafted the Copenhagen Accord in accordance to post-Kyoto negotiations, with the US and developing countries such as China, India, Brazil, and South Africa having a crucial role in drafting the document. The Copenhagen Accord pledges to limit global temperature increase of 2 ^{o}C to avoid dangerous anthropogenic interference with the climate system. Additionally, the accord embraces a Copenhagen Green Climate Fund that delivers financial support to the most vulnerable developing countries for combating climate change either by mitigation or adaptation efforts.

The Kyoto Protocol is now two years into its enforcement. There is a necessity to analyze its midterm performance. The effectiveness of the Kyoto Protocol should be highlighted in subsequent climate change discussions in attuning its current methodology or distinguishing other approaches for stringent efforts to achieve positive climate change. Additionally, commentaries on the Copenhagen Accord should also be delivered in order to ensure the political will of pursuing poverty eradication and sustainable development in a low emission pathway. This paper, therefore, addresses the analysis of two methods (Kyoto Protocol and Copenhagen Accord) that represent the autonomous initiative of human society for its sustainable future.

2. Midterm analysis of the Kyoto Protocol

The beginning of 2010 meant that the Kyoto Protocol had formally entered the first commitment period for two full years. It is essential for midterm investigation regarding the accomplishments of the nations that have ratified the Kyoto Protocol, in terms of the ultimate goal of GHG emissions reduction to mitigate global warming. Due to the fact that it requires about two years for the data collection to take place before an official GHG inventory can be published, governance reports were updated until 2007. Notwithstanding, GHG emissions could be predicted for analysis purposes and these projections are found to be reliable.

In this paper, the GHG emission inventories of several major emitters will be discussed. Annex I countries of the Kyoto Protocol such as the European Union (EU), Japan, and Russia will be analyzed in terms of their efficiency in achieving their Kyoto pledge. The US and non-Annex I countries such as China and India will be analyzed in terms of their negative influences on goals of the Kyoto Protocol. The EU, as one of the major contributors towards the foundation of the Kyoto Protocol, obligates a GHG reduction of 8% in 2008–2012 [11]. In 2007, the overall GHG emissions from EU-27 were 9.3% below 1990, in which GHG emissions drop from 5564.0 to 5045.1 million tons of CO_2 (without LULUCF – land use, land use change and forestry), indicating their success in achieving their Kyoto commitments [5]. Among the European countries, EU-12 (mainly Eastern Europe) had actually achieved a GHG emission reduction of 25.4% in 2007. Nevertheless, EU-15, especially Spain and Portugal, which account for local emission rise of 52.6% and 36.1%, respectively, offset the total amount of EU reduction [4]. In total, the emission reduction of EU-15 approached 4.3%, which is lower than the 8% target [5]. This shows that EU-15 is not capable of realizing their Kyoto pledge, and the successfulness of EU-27 is merely due to the contribution from EU-12. The emission reduction of 25.4% by EU-12 was, on the other hand, mainly due to the collapse of their economies rather than the effectiveness of their efforts. This illustrates that even though the EU could comply with their Kyoto commitments; a much more ambitious Kyoto target should be adopted for a sustainable future.

Russia is the second largest emitter of the countries that have ratified the Kyoto Protocol (after the EU), and has a commitment to maintain its GHG emissions at base year level [11]. Russian energy related CO_2 emissions in 2007 were 1.6 Gt or 27.3% below its 1990 level (2.2 Gt) [6]. However, this reduction did not imply the accomplishment of the Kyoto Protocol, as the steep reduction of Russian GHG emissions was due to the transition to a market economy. Nevertheless, there was indeed some effort demonstrated by the improvement of the CO_2 intensity index (world 2007 = 100) between 1990 and 2007 [6]. The decrease of the CO_2 intensity index from 250 to 171 showed that some enhancement in the energy utilization was achieved. Apart from Russia, Japan is listed in Annex I of the Kyoto Protocol and has a GHG emissions reduction commitment of 6% from 1990 [11]. Lau et al. (2009) shows the awareness of the Japanese government in incorporating ideas of sustainable development in the processes of formulating their energy policies. Therefore, Japan emerges as one of the most energy efficient countries with the lowest CO_2 intensity index of 71 (world 2007 = 100) [6]. Nevertheless, the energy related CO_2 emissions of Japan in 2007 did not decrease compared to 1990 because the emissions rose from 1.1 Gt to 1.2 Gt [6]. From the emission data reported by corresponding countries, it is reasonable to conclude that achieving the goals of the Kyoto Protocol is less likely to occur, even with such a low target.

Since emission reduction difficulties in Annex I countries were expected as the cost of carbon reduction is higher in nations that have already achieved high energy efficiency, fostering CDM as an alternative for cheaper carbon reduction method is crucial for Annex I nations to achieve their pledge. Even though there are three mechanisms proposed by the Kyoto Protocol, CDM emerges as far more important than the other two. Rahman et al. [10] shows that by August 2009, 5316 CDM projects have been submitted to the UNFCCC. Despite 685 projects being rejected or withdrawn, the remaining 4631 projects are expected to generate approximately 2.79 billion certified emission reductions (CERs) [10]. The most popular project types are hydro, wind, biomass energy, and methane avoidance, which account for roughly 70% of the total 4631 CDM projects. Additionally, the CDM is also on track to generate 1100 million CERs annually by 2020. Nevertheless, the 2.79 billion CERs generated are sufficient to aid developed countries in achieving their Kyoto pledges but could likely fail to offset the emissions increase by the US and other developing countries, as discussed in the next section. In addition to providing cheaper alternatives for Annex I countries' Kyoto pledges, the CDM also promotes technology transfer and sustainable development of the host country. Therefore, the CDM or other similar mechanisms are expected to continue beyond the first commitment period as an effective and economically feasible method for achieving carbon reduction.

One of the loopholes of the Kyoto Protocol is the withdrawal of the US from the treaty. The implication of the US leaving this international pact serves to nullify the effort of the nations that have ratified the Kyoto Protocol, since US is the largest emitter among developed countries. The US is required to commit a reduction of 7% if it ratifies the Kyoto Protocol in US Congress [11]. The US federal

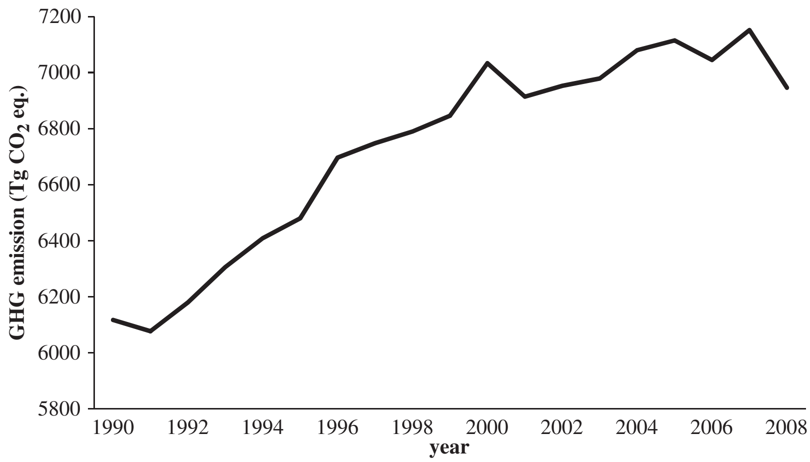


Fig. 1. US GHG emissions from 1990–2008.

Table 1
Share of cumulative world CO_2 emission

	1990	2007	2020[a]	2030[a]
EU	27	23	20	18
US	31	28	25	23
Japan	4	4	4	4
Russia	14	11	10	9
India	2	3	3	4
China	5	9	13	16

[a] Prediction of a scenario in which governments do not make changes to their existing policies by mid 2009.

government refuses to commit to a binding environmental treaty and claims that for economical consideration. US keeps good track record of its GHG emissions and publishes inventory reports as soon as possible. On top of that, state governments in the US, in contrary to the federal government, have set their own emissions caps and have enacted various environmental policies as global mitigation efforts. Therefore, in an optimistic perception, the US federal government could potentially adopt the Kyoto Protocol or post-Kyoto Protocol negotiations eventually. Nevertheless, without a binding treaty, the US GHG emissions, as shown in Fig. 1, grew 14% from 6116.6 Tg in 1990 to 6946.1 Tg in 2008 [14]. The emissions in 2008 had actually decreased 2.9% from 2007, which is the largest decrease percentage to take place since 1990. However, the extra 829.5 Tg of CO_2-eq emissions from 1990 have definitely offset the effort by other Annex I countries, and are subsequently a harsh burden on the goals to achieve a collective 5.2% reduction.

Apart from the withdrawal of the US from the Kyoto Protocol, exclusion of developing countries from quantified emission reduction commitment has been a detrimental decision towards global warming mitigation. Even though not including least developed countries and small island developing countries, fast growing developing countries envisaged in non-Annex I countries such as China and India have shown their rapid growing GHG emission recently. China overtook the US as the largest CO_2 emitter in 2006 and India replaced Russia as the third in the world in 2007 [2]. China has never reported its GHG emission officially since 1994. The attained estimate shows that Chinese fossil fuel CO_2 emissions in 2008 had reached 7.05 Gt [2], more than triple compared to her 2.2 Gt emission in 1990 [6]. China's immense growth in CO_2 emission has humiliated the emission reduction goals set by the Kyoto Protocol, even if it was achieved. Other than that, Table 1 shows the shares of the cumulative world CO_2 emission of several countries. China's share of cumulative world CO_2 emission has increased from 5% in 1990 to 9% in 2007 with a constitution of 20% of the world population [6]. Therefore, China has started to lose the stand to claim that current atmospheric CO_2 concentration are caused by developed countries since the pre-industrial era. Conversely, India has shown a double increase in its 2007 energy related CO_2 emissions, compared to 1990. The emissions rose from 0.60 Gt to 1.3 Gt and are projected to reach 2.2 Gt in 2020 [6]. However, India's share of the cumulative world CO_2 emission was only 3% in 2007, whereas it contains 17% of world's population [6]. There is a necessity for India to emphasize its priority in poverty eradication and pursue social and economic development. Nevertheless, India could obtain financial aid and technology transfer from developed countries, as its CO_2 intensity index (world 2007 = 100) is 101, which is relatively high and improved utilization of energy is required [6].

3. From the Kyoto Protocol to the Copenhagen Accord

The Conference of Parties (COP) of UNFCCC, since 1995, has organized a series of meetings annually in order to discuss pressing climate issues. After the enforcement of the Kyoto Protocol began in 2005, COP 11 was also the first Meeting of Parties (MOP 1) of the Kyoto Protocol in order to negotiate issues related to the Kyoto Protocol. In 2007, MOP 3 was held, where negotiation was raised for a climate change mitigation framework extending beyond 2012, and the Bali Action Plan was outlined. In the Bali Action Plan, the parties aim to formulate a binding deal in two year, i.e., in the Copenhagen meeting. Eventually, COP 15/MOP 5 was held in Copenhagen in December 2009. Ultimately, COP 15/MOP 5 did not attain a binding deal for combating climate change, but instead adopted the Copenhagen Accord as the post-Kyoto climate agreement and it is subject to further negotiations.

The Copenhagen Accord promotes the stabilization of atmospheric GHG concentrations in order to prevent dangerous climate change by suppressing the rise of global temperature below 2 °C in accordance with the principles of common but differentiated responsibility and respective capabilities. The accord does not set a global or national emissions limit, but rather recognizes the necessity to immediately achieve a suppression of emissions. Parties of the Copenhagen Accord will set their own emissions targets, either individually or jointly. Subsequently, these targets will be verified according to whether Annex I or non-Annex I countries. Also, emission from deforestation and forest degradation (REDD)

and removal of GHG by forests are identified as crucial in combating climate change by providing financial incentives through a REDD-plus mechanism. Developed countries promise to commit USD 30 billion from 2010–2012 and USD 100 billion annually by 2020 to aid the developing world, especially the least developed countries, small island developing states, and Africa through the Copenhagen Green Climate Fund for adaptation and mitigation including REDD-plus, capacity building, technology development and transfer.

Contradictory to the Kyoto Protocol, developing countries such as China, India, Brazil and South Africa played an important role in negotiations with the US in the efforts to draft the Copenhagen Accord. This is a positive trend, in that the participation of developing countries, especially China and India, implies climate change mitigation of higher effectiveness compared to the solo work of developed countries. But there is no doubt that opinions of dissatisfaction would arise, as many countries claim that their economical benefits and opinions were not considered during the drafting of the Copenhagen Accord. For instance, Small Island developing states such as Tuvalu urged that stringent temperature increase of less than 1.5 °C should instead be adopted. The president of Tuvalu pleaded that his country would sink under the water at 2 °C increase because the IPCC [7] indicates a 0.4–1.4 m rise in sea level due to the thermal expansion of water only. In addition to the thermal expansion of water, melting of glaciers, ice caps and Greenland could cause a potential 7 m sea level increase. Catastrophic outcome is expected for Tuvalu, as the highest point in Tuvalu is only 4 m and the entire Tuvaluan population lives less than 2 m above sea level [15]. Thus, the request for limiting temperature increase to below 1.5 °C for a secure position to countries that could not adapt the climate change, especially for those island countries, was perfectly reasonable.

In spite of the 2 °C aim that seems inadequate and less ambitious, global GHG emissions by 2020 must be capped to 44 billion tons of CO_2-eq in order to have a 50% chance to achieve the goal [1]. This implies an essential step for developed countries to reduce 30% of emissions by 2020 and then further increase to 50% by 2050 [3]. Under such condition, atmospheric GHG concentration could be limited within 400–450 ppm CO_2-eq to avoid the dangerous impacts of climate change [8]. Even though a 2 °C objective is agreed, there is no explicit target of how it could be achieved. The accord is instead providing an appendix for the countries to submit their own targets and mitigation actions for verification. Comparing to the Kyoto Protocol as an international treaty, the Copenhagen Accord is not a binding deal that could effectively regulate the actions of the parties. The accord merely provides an appendix for both developed (Appendix I) and developing countries (Appendix II) to submit their commitment in their own quantified economy-wide emissions targets for 2020 and climate change mitigation actions voluntarily. This provides substantial convenience for the parties to promise no commitment or reasonable emission reduction goal corresponding to their political will. Some of the reports accepted under the Appendix I and II in the Copenhagen Accord are shown in Table 2 and Table 3 [13]. The report submission of most of the major GHG emitters without delay indicates a harmonized desire to contribute in limiting the temperature rise to 2 °C. However, there is a doubt raised against the feasibility of the targets and actions taken, and whether the goal of 2 °C could be achieved. Many countries, such as, Australia and the EU, are also willing to contribute more in GHG mitigation actions under the condition that a comparable effort is offered globally. This action results from the intention of protecting their economy along with devotion to climate change mitigation. Therefore, tedious and time-consuming negotiations are expected to occur in order to achieve a global and comprehensive multilateral agreement that will indeed meet the objective of the Copenhagen Accord.

Table 2
Quantified economy-wide emissions targets for 2020 of developed countries submitted under Appendix I of the Copenhagen Accord.

Developed countries	Quantified economy-wide emissions targets for 2020
Australia	5% (unconditional), 15% (conditional)-25% (stringent conditions) from 2000 level
Canada	17% reduction from 2005 level
EU	20% reduction from 1990 level, contingent increase to 30%
Japan	25% reduction from 1990 level
Russia	15–25% reduction from 1990 level
US	17% reduction from 2005 level

Table 3
Mitigation action plans of developing countries submitted under Appendix II of the Copenhagen Accord.

Developing countries	Mitigation actions
Brazil	36.1–38.9% reduction from BAU
China	Reduce 40–45% of CO_2 emission/GDP, increase non fossil fuel share to 15%, increase forest coverage and forest stock volume by 40 million hectares and 1.3 billion m^3, base year 2005
India	Reduce 20–25% CO_2 emission/GDP from 2005 level
Indonesia	26%, base year not stated
South Africa	34% reduction from BAU by 2020, 42% reduction from BAU by 2025

*BAU = business as usual

In addition to limiting temperature increase, the accord pledges to provide the Copenhagen Green Climate Fund to aid poor developing countries take part in climate change adaptation and mitigation. However, the funding of USD 30 billion in 2010–2012 is minuscule when considered in terms of the broad range expenditure of adaptation and mitigation actions. For instance, the cost of defending Venice from sea level rise and tides for a year has already required the full amount of provided funding. The economic damage brought about by Katrina was five times greater than the USD 30 billion from Copenhagen Green Climate Fund [9]. Therefore, larger financial support from rich developed countries is necessary for the least developed countries. Additionally, it is not difficult to come to a conclusion that mitigation and adaptation costs are much smaller than the damage caused by the effects of climate change. Other than the little funding promised by developed countries, the Copenhagen Accord does not clearly allocate the Green Climate Fund to corresponding adaptation and mitigation programs. In this vein, the accord raises confusion for host countries in obtaining the financial aid for their adaptation and mitigation plans. In addition, the fund transfer could not progressively allow the appropriate actions to be taken in the fight against climate change. It is unfortunate that politicians are economists rather than scientists or mathematicians. They are ignoring the warnings given by scientists and potential future loss due to climate change; they instead focus on their short term economical advantages and of course, their political benefits.

The convention is unable to determine a deadline for emission peaking by stating that it should be achieved 'as soon as possible' [12]. In the Kyoto Protocol on the other hand, the performance of the ratifying nations could be analyzed through their actual emissions and their QELRC, but the Copenhagen Accord, as a post-Kyoto negotiation output, could not decide to further complement the Kyoto Protocol or establish a better and ambitious internationally binding treaty for climate change mitigation. In addition, it is rather disappointing that there are no obvious

improvements from preceding experience in formulating the Kyoto Protocol; especially since the Copenhagen Accord has been given six years for assessment. It is inevitable to doubt the necessity of such a long period time between commencement and the assessment. Subsequently, it can be considered that there is no solid international effort in terms of climate change mitigation between 2012 and 2015. The global society will continue to waste time in negotiations instead of putting real effort into subverting this severe issue that could potentially harm the existence of not just the world's fragile ecosystems, but human being also.

4. Conclusion

From the GHG emission inventory reported by various nations and their emissions projection, the Kyoto Protocol could be accepted as successful to the extent that the Kyoto goal is achievable. From a global warming mitigation perspective, the Kyoto Protocol could not reduce global GHG emissions. Nevertheless, the Kyoto Protocol is not a complete failure, as the efforts of the developed countries can be called a good 'first step'. The Copenhagen Accord is not a complete failure either, as it can also be called a good initial step in terms of global effort, including developing countries. However, how many first steps do we need before we can actually commit fully towards climate change mitigation? How many steps do we have left before it is too late?

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